MSC Guidelines for the Review of Fire Main Systems

Procedure Number: E1-9 Revision Date: 9/9/99

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References

(a) Navigation and Vessel Inspection Circular No. 6-72, Chg. 1, Guide to Fixed Fire Fighting Equipment Aboard Merchant Vessels
(b) The International Convention for the Safety of Life at Sea (SOLAS), 1974, and its Protocol of 1978
(c) 46 CFR 34.10 (Sub Chapter "D") Fire Main System, Details
(d) 46 CFR Part 56 (Sub Chapter "F") Marine Engineering

Disclaimer

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Subchapter D - Fire Main Systems

General Information

- Fire pumps, piping, hydrants, hose and nozzles shall be installed on all tankships, the arrangements and details of which shall be as set forth in 46 CFR 34.10 per 46 CFR 34.05-1.
- Installations contracted for prior to May 26, 1965, shall meet the requirements of 46 CFR 34.10-90 per 46 CFR 34.10-1(a).
- If a fire main system is installed on a tank barge, the system shall meet the intent of 46 CFR 34.10 insofar as reasonable and practicable per 46 CFR 34.10-1(b).

Fire Pumps

- Tankships shall be equipped with independently driven fire pumps in accordance with table 34.10-5(a).
- Each pump shall be capable of delivering simultaneously the number of streams of water required by table 34.10-5(a) from the outlets having the greatest pressure drop between fire pump(s) and nozzles at a Pitot tube pressure of approximately 75 p.s.i. **Note:** Where 1 ½ inch hose is permitted in lieu of 2 1/2-inch hose by footnote 4 of Table 34.10-5(a), the pump capacity shall be determined on the basis that both hoses are used per 46 CFR 34.10-5(b).
- Fire pumps shall be fitted on the discharge side with relief valves set to relieve at 25 p.s.i. in excess of the pressure necessary to maintain the requirements of paragraph (b) of this section per 46 CFR 34.10-5(d).
- In no case shall a pump having connection to an oil line be used as a fire pump per 46 CFR 34.10-5(f).
- Branch lines connected to the fire main for purposes other than fire and deck wash shall be arranged so that the requirements of paragraph (b) of this section and any other services installed on the fire main can be met simultaneously per 46 CFR 34.10-5(f).
- On all vessels where two fire pumps are required, they shall be located in separate spaces, and the arrangement of pumps, sea connections, and sources of power shall be such as to insure that a fire in any one space will not put all of the fire pumps out of operation per 46 CFR 34.10-5(g). **However,** where it is shown to the satisfaction of the Commandant that it is unreasonable or impracticable to meet this requirement due to the size, or arrangement of the vessel, or for other reasons, the installation of a total flooding carbon dioxide system may be accepted as an alternate method of extinguishing any fire which would affect the powering and operation of at least one of the required fire pumps. See attachment 1 Fire Pump Location & Separation of Spaces.
- Fire pumps shall be fitted with a pressure gage on the discharge side of the pumps per 46 CFR 34.10-5(e).
- Fire pumps may be used for other purposes provided at least one of the required pumps is kept available for use on the firemain system at all times per 46 CFR 34.10-5(f).

Fire station hydrants

- The size of fire station hydrants and hose required shall be as noted in Table 34.10-5(a).
- Fire hydrants shall be of sufficient number and so located that any part of living quarters, storerooms, working spaces and weather decks accessible to crew while at sea may be reached with two effective spray patterns of water,

one of which shall be from a single 50-foot length of hose. In main machinery spaces all portions of such spaces shall be capable of being reached by at least 2 effective spray patterns of water, each of which shall be from a single 50-foot length of hose from separate outlets per 46 CFR 34.10-10(b).

- Fire station hydrant connections shall be brass, bronze, or other equivalent metal. per 46 CFR 34.10-10(i).
- Couplings shall either: use National Standard fire hose coupling threads for the 1 ½ inch (38 millimeter) and 2 1/2 inch (64 millimeter) hose sizes, i.e. 9 threads per inch for 1 1/2 inch hose, and 7 ½ threads per inch for 2 1/2 inch hose; or be a uniform design for each hose diameter throughout the vessel per 46 CFR (i)(1)&(2).
- Each fire station hydrant or ``y'' branch shall be equipped with a valve so that the hose may be removed while there is pressure on the fire main per 46 CFR 34.10-10(h).
- The outlets at the fire station hydrant shall be limited to any position from the horizontal to the vertical pointing downward so that hose will lead horizontally or downward to minimize possibility of kinking per 46 CFR 34.10-10(c).
- All fire station hydrants shall be equipped with spanners suitable for use on the hose at that station per 46 CFR 34.10-10(d).
- Each fire station hydrant must have at least 1 length of fire hose per 46 CFR 34.10-10(e).
- The pipes and fire station hydrants shall be so placed that the fire hose may be easily coupled to them per 46 CFR 34.10-10(g).
- All hydrants shall be so located as to be readily accessible per 46 CFR 34.10-10(g).
- If deck cargo is carried, it shall not interfere with access to the fire station hydrants, and the pipes shall be arranged as far as practicable to avoid risk of damage by such cargo per 46 CFR 34.10-10(g).

Fire Hose and Nozzles

Table 34.10-10(e) Hydrants with Coast Guard Approved Low-Velocity Water Spray Applicators

Location	Number of hydrants with approved applicators	Approved applicator length (feet)
Living Space Weather Deck Machinery Space	... ...1 ... .4 2	... ...4 ... ...10 or 12 4

- Each combination firehose nozzle previously approved under 46 CFR 162.027 in the locations listed in table 34.10-10(e) must have a low-velocity water spray

applicator also previously approved under subpart 162.027 of this chapter that is of the length listed in that table per 46 CFR 34.10-10(e).

- Fire hose shall be 50 feet in length except on weather decks the hose shall be increased in length if necessary to enable a single length to be goose-necked over each side of the vessel per 46 CFR 34.10-10(j).
- If two fire mains are installed on the weather decks, the length of hose shall be such that it may be goose-necked over the side from the nearest fire main per 46 CFR 34.10-10(j).Each section of fire hose used after January 1, 1980 must be lined commercial fire hose that conforms to Underwriters' Laboratories, Inc. Standard 19 or Federal Specification ZZ-H-451E per 46 CFR 34.10-10(m). **Note:** Hose that bears the label of Underwriters' Laboratories, Inc. as lined fire hose is accepted as conforming to this requirement. Each section of replacement fire hose or any section of new fire hose placed aboard a vessel after January 1, 1977 must also conform to the specification required by this paragraph.
- Coupling shall conform to the requirements of 46 CFR 34.10-10(i) per 46 CFR 34.10-10(n).
- Each firehose at a hydrant must have a combination solid stream and water spray firehose nozzle that meets the requirements in subpart 162.027 of this chapter per 46 CFR 34.10-10(e).
- Firehose nozzles previously approved under subpart 162.027 of this chapter may be retained so long as they are maintained in good condition to the satisfaction of the Officer in Charge, Marine Inspection per 46 CFR 34.10-10(e).
- Fire hose when part of the fire equipment shall not be used for any other purpose than fire extinguishing, fire drills, and testing per 46 CFR 34.10-10(k).
- Fire hose shall be connected to outlets at all times per 46 CFR 34.10-10(l). **However**, in heavy weather on open decks where no protection is afforded the hose may be removed temporarily from the hydrant and stowed in an accessible location nearby. While in port, fire hose in way of cargo area shall be kept ready for immediate use. The fire hose may be temporarily removed when it will interfere with the handling of cargo.
- A suitable hose rack or other device must be provided for each hose per 46 CFR 34.10-10(e).
- Hose racks on weather decks must be located to afford protection from heavy seas per 46 CFR 34.10-10(e). The hose must be stored in a location that is readily visible.
- Each low-velocity water spray applicator must have fixed brackets, hooks, or other means for stowing next to the hydrant per 46 CFR 34.10-10(o).

Piping

- All piping, valves and fittings shall meet the applicable requirements of 46 CFR part 56 (Marine Engineering) per 46 CFR 34.10-15(a)
- An adequate number of valves shall be installed to isolate damaged sections of piping per 46 CFR 34.10-15(b). **Except that:**
- Self-propelled vessels carrying bulk liquefied gases must have stop valves: (1) At cross connections; (2) At the front of the after deck house; and (3) In the cargo area spaced 40 m (131 ft.) or less between hydrants per 46 CFR 34.10-15(b).
- All distribution valves shall be marked as required by 46 CFR 35.40-10 per 46 CFR 34.10-15(c).

➢ Systems contracted for prior to May 26th, 1965

- Installations contracted before May 26, 1965 must meet the requirements outlined in 46 CFR 34.10-90.

➢ Additional Requirements For Vessels on an International Voyage

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Fire pumps

- Each required fire pump, on tankships of 1,000 gross tons and over on an international voyage, while delivering water through the fire main system at a pressure corresponding to that required by 46 CFR 34.10-15(e), shall have a minimum capacity of at least two-thirds of that required for an independent bilge pump if no length correction is taken for the cargo tank space. However, in no case shall the capacity of each fire pump be less than that otherwise required by 46 CFR part 34 per 46 CFR 34.10-5(c).

- **Fire main**

- The diameter of the fire main, on tank ships on an international voyage, shall be sufficient for the effective distribution of the maximum required discharge from two fire pumps operating simultaneously per 46 CFR 34.10-15(e). Note: This requirement is in addition to 46 CFR 34.10-5(b). The discharge of this quantity of water through hoses and nozzles at a sufficient number of adjacent hydrants shall be at a minimum Pitot tube pressure of

  approximately 71 psi pounds per square inch on self-propelled vessels that carry bulk liquefied gases and approximately 50 psi on other tank ships.

- Tankships of 500 gross tons and over on an international voyage must be provided with at least one international shore connection which meets ASTM F-1121 per 46 CFR 34.10-15(d).
- Facilities must be available enabling the international shore connection to be used on either side of the vessel per 46 CFR 34.10-15(d).

- **SOLAS**

- Vessels on an international voyage must meet SOLAS requirements. See attachment 2 located at the end of this document for guidance.

Attachments

Attachment 1: **FIRE PUMP LOCATION / SEPARATION OF SPACES**

Attachment 2: **SOLAS REVIEW GUIDE - FIRE MAIN**

Subchapter	Description	Capacity and/or PSI
(D)	**46 CFR 34.10**	

Tank Vessels	Vessels not over 100 ft	No fire pump required – see table 34.10-5(a) for B-V extinguisher requirements.
	Vessels over 100 ft but not over 250 ft not on an international voyage	1 fire pump required. The pump must have the capacity to simultaneously deliver 2 powerful streams of water from the hydrants having greatest pressure drop between the fire pump and nozzle at 75 psi. 1 ½ inch hydrant and hose sizes at interior and exterior stations. **Note:** If 1000 GT and over and on an international voyage then 2 pumps are required the capacity of which are determined as noted for vessels on international voyages in Table (2).
	Vessels over 250 ft but not over 400 ft not on an international voyage	2 fire pumps required. Each pump must have the capacity to simultaneously deliver 2 powerful streams of water from the hydrants having greatest pressure drop between the fire pump(s) and nozzle at 75 psi. 1 ½ inch hydrant and hose sizes at interior and exterior stations.
	Vessels over 400 ft but not over 650 ft not on an international voyage	2 fire pumps required. Each pump must have the capacity to simultaneously deliver 2 powerful streams of water from the hydrants having greatest pressure drop between the fire pump(s) and nozzle at 75 psi. 1 ½ inch hydrant and hose sizes at interior stations and 2 ½ inch hydrant and hose sizes on exterior stations. **Note**: 2½ inch hoses may be substituted with (2) 1½ inch hoses.
	Vessels over 650 ft not on an international voyage	2 fire pumps required. Each pump must have the capacity to simultaneously deliver 3 powerful streams of water from the hydrants having greatest pressure drop between the fire pump(s) and nozzle at 75 psi. 1 ½ inch hydrant and hose sizes at interior stations and 2 ½ inch hydrant and hose sizes on exterior stations. **Note**: 2½ inch hoses may be substituted with (2) 1½ inch hoses.
	Table 1 **Sub Chapter D** **Pump capacity for vessels on an international voyage**	

	$d = 1 + \sqrt{\frac{L(B+D)}{2500}}$ in English units or $d = 25 + \sqrt{L(B+D)}$ in metric units Find diameter and select pipe size. After pipe size is selected, determine the internal area and then determine capacity required of the bilge pump from the following equation: 6.67 x Area (in^2) ---------- = Q (GPM) .3208 Total Fire Pump Capacity = 2Q/3	Each required fire pump, while delivering water thru the fire main capable of delivering 75 psi to the required number of outlets shall have a minimum capacity of at least equal to 2/3's of that required for an independent bilge pump **if no length correction is taken for the cargo tanks** as allowed by the note 1 in 46 CFR 56.50-50(d)(1). The bilge pump is sized according to formula 1 in subchapter (F) – 46 CFR 56.50-50 depending on the required diameter of the bilge suction inlet which is calculated from L, B, and D, in order to achieve a minimum velocity of 400 fpm. **Note: When 1½ hoses are used in lieu of 2½ hoses, the required pump capacity is determined as if 2½ hoses are installed per 46 CFR 95.10-5(c). Two 1½ hoses connected to the hydrant is considered equal to one 2½ hose for this purpose.**

Table 2

References

(e) Navigation and Vessel Inspection Circular No. 6-72, Chg. 1, Guide to Fixed Fire Fighting Equipment Aboard Merchant Vessels
(f) The International Convention for the Safety of Life at Sea (SOLAS), 1974, and its Protocol of 1978
(g) 46 CFR 76.10 (Sub Chapter "H") Fire Main System, Details
(h) 46 CFR Part 56 (Sub Chapter "F) Marine Engineering

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Fire Pumps

- Vessels shall be equipped with independently driven fire pumps in accordance with 46 CFR table 76.10-5(a). See table 1 provided at the end of this document for assistance.
- Each pump shall be capable of delivering water simultaneously from the two highest outlets at a pitot tube pressure of approximately 50 psi per 46 CFR 76.10-5(b).
- Fire pumps shall be fitted on the discharge side with relief valves set to relieve at 25 psi in excess of the pressure necessary to maintain 50 psi at the two highest outlets simultaneously or 125 psi., whichever is greater per 46 CFR 76.10-5(d). Relief valves may be omitted if the pumps, operating under shut-off conditions, are not capable of developing a pressure exceeding this amount.
- Pumps connected to oil lines may not be used as a fire pump per 46 CFR 76.10-5(f).

- Branch lines connected to the fire main for purposes other than fire and deck wash shall be so arranged that the required pressure and capacities of the fire pump and any other services installed on the fire main can be met simultaneously per 46 CFR 76.10-5(f).
- The total area of the pipes leading from a pump shall not be less than the discharge area of the pump per 46 CFR 76.10-5(g).
- On vessels with oil fired boilers, either main or auxiliary, or with internal combustion propulsion machinery, where 2 fire pumps are required, they shall be located in separate spaces, and the arrangement of pumps, sea connections, and sources of power shall be such as to insure that a fire in any one space will not put all of the fire pumps out of operation per 46 CFR 76.10-5(h). See attachment 1 Fire Pump Location / Separation of Spaces.
- Where it is shown to the satisfaction of the Commandant that it is unreasonable to locate the fire pumps in separate spaces due to the size or arrangement of the vessel, or for other reasons, the installation of a total flooding carbon dioxide system may be accepted as an alternate method of extinguishing any fire which would affect the powering and operation of at least one of the required fire pumps per 46 CFR 76-10.5(h).
- Fire pumps shall be fitted with a pressure gage on the discharge side of the pumps per 46 CFR 76.10-5(e).
- Fire pumps may be used for other purposes provided at least one of the required pumps is kept available for use on the fire system at all times per 46 CFR 76.10-5(f).

Fire Main and Hydrants

- The size of fire hydrants, hose, and nozzles and the length of hose required shall be as noted in 46 CFR table 76.10-5(a) per 46 CFR 76.10-10(a). See table 1 provided at the end of this document for assistance.
- On vessels over 1500 GT, where 46 CFR table 95.10-5(a) specifies the use of 2 ½ -inch hose and hydrants, the hydrants in interior locations may have siamese connections for 1 ½ -inch hose. In these cases the hose shall be 75 feet in length, and only one hose will be required at each fire station; however, if all such stations can be satisfactorily served with 50-foot lengths, 50-foot hose may be used per 46 CFR 76.10-10(b).
- On vessels of 500 gross tons and over there must be at least one shore connection to the fire main available to each side of the vessel in an accessible location per 46 CFR 76.10-10(c).
- Suitable cut-out valves and check valves must be provided for shore connections per 46 CFR 76.10-10(c).
- Suitable adaptors must be provided for furnishing the vessel's shore connections with couplings mating those on the shore fire lines per 46 CFR 76.10-10(c).

- Fire hydrants shall be of sufficient number and so located that any part of the vessel, other than main machinery spaces, accessible to the passengers or crew while the vessel is being navigated and all cargo holds may be reached with at least two streams of water from separate outlets, at least one of which shall be from a single length of hose per 46 CFR 76.10-10(d). **Note:** For the purpose of this requirement, all watertight doors and all doors in main vertical zone bulkheads and stairway enclosures shall be closed, although hose ports may be installed in doors other than watertight doors and doors in main vertical zone bulkheads for the passage of the hose.
- In main machinery spaces, all portions at such spaces shall be capable of being reached by at least two streams of water, each of which shall be from a single length of hose from separate outlets per 46 CFR 76.10-10(d. **Note:** This requirement need not apply to shaft alleys containing no assigned space for the stowage of combustibles.
- Outlets shall be limited to any position from the horizontal to the vertical pointing downward, so that the hose will lead horizontally or downward to minimize the possibility of kinking per 46 CFR 76.10-10(f).
- Each fire hydrant must have at least one length of fire hose, a spanner, and a hose rack or other device for stowing the hose per 46 CFR 76.10-10(g).
- The outlet at each fire hydrant shall be provided with a cock or valve fitted in such a position that the fire hose may be removed while the fire main is under pressure per 46 CFR 76.10-10(f).
- All parts of the fire main located on exposed decks shall either be protected against freezing or be fitted with cut-out valves and drain valves so that the entire exposed parts of such piping may be shut off and drained in freezing weather. Except when closed to prevent freezing, such valves shall be sealed open per 46 CFR 76.10-10(e).
- Fire hydrants shall be numbered as required 46 CFR 78.47-20 per 46 CFR 76.10-10(d).

Fire Hose and Nozzles

- Each firehose on each hydrant must have a combination solid stream and water spray firehose nozzle that meets the requirements in subpart 162.027 of this chapter per 46 CFR 76.10-10(j).
- The minimum size orifice for fire hose nozzles shall be as specified by 46 CFR table 76.10-5(a).
- Fire hose nozzles previously approved under subpart 162.027 of this chapter must have low-velocity water spray applicators also previously approved under subpart 162.027 of this chapter as follows:
- Accommodation and service areas must have two fire hoses with low-velocity water spray applicators of not more than 1.8 meters (6 feet) per 46 CFR 76.10-10(k)(1).

- Each fire hose, on a vessel 1000 GT or more, in propulsion machinery spaces containing an oil-fired boiler, internal combustion machinery, or oil fuel unit must have a low-velocity water spray applicator of not more than 1.8 meters (6 feet)per 46 CFR 76.10-10(k)(2).
- Fire hydrants, nozzles, and other fittings shall have threads to accommodate the hose connections noted in 46 CFR 76.10-10(l).
- Fire hose couplings shall either use National Standard fire hose coupling 9 threads per inch for 1 ½ inch (38 millimeter) and 7 ½ inch threads per inch for 2 ½ inch (64 millimeter) hose sizes or be a uniform design, for each hose diameter throughout the vessel per 46 CFR 76.10-10(n)(1)(i)&(ii).
- Fire hose nozzles previously approved under subpart 162.027 of this chapter may be retained so long as they are maintained in good condition to the satisfaction of the Officer in Charge, Marine Inspection per 46 CFR 76.10-10(j).
- Fire station hydrant connections shall be brass, bronze, or other equivalent metal per 46 CFR 76.10-10(n)(1)
- Each section of firehose must be lined commercial firehose that conforms to Underwriters' Laboratories, Inc. Standard 19 or Federal Specification ZZ-H-451E per 46 CFR 76.10-10(n)(2). **Note:** Hose that bears the label of Underwriters' Lab of Underwriters' Laboratories, Inc. as lined firehose is accepted as conforming to this requirement.
- Fire hose shall be connected to the outlets at all times. However, on open decks where no protection is afforded to the hose in heavy weather, or where the hose may be liable to damage from the handling of cargo the hose may be temporarily removed from the hydrant and stowed in an accessible nearby location per 46 CFR 76.10-10(h).
- Fire hose shall not be used for any other purpose than fire extinguishing and fire drills per 46 CFR 76.10-10(i).
- Fixed brackets, hooks, or other means for stowing an applicator must be next to each fire hydrant that has an applicator per 46 CFR 76.10-10(l).

Piping

- All piping, valves, and fittings shall meet the applicable requirements of subchapter F (Marine Engineering) per 46 CFR 76.10-15(a)
- All distribution cut-off valves shall be marked as required by 46 CFR 78.47-15 per 46 CFR 76.10-15(b).

Additional Requirements For Vessels on an International Voyage

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Fire Pumps

- Vessels on an international voyage shall have a minimum total fire pump capacity at least equal to two-thirds of the required total bilge pump capacity, but in no case less than that required per 46 CFR 76.10-5(b).
- Each of the required fire pumps on vessels on an international voyage shall have a capacity not less than 80 percent of the total required capacity divided by the number of required pumps per 46 CFR 76.10-5(b).

- **Fire Hydrants and Hoses**

- Vessels 500 gross tons and over on an international voyage, must be provided with at least one international shore connection complying with ASTM F-1121 per 46 CFR 76.10-10(c).
- Facilities must be available enabling an international shore connection to be used on either side of the vessel per 46 CFR 76.10-10(c).
- Each fire hose in propulsion machinery spaces containing an oil-fired boiler, internal combustion machinery, or oil fuel unit must have a low-velocity water spray applicator of not more than 1.8 meters (6 feet)per 46 CFR 76.10-10(k)(2).
- Fixed brackets, hooks, or other means for stowing an applicator must be next to each fire hydrant that has an applicator per 46 CFR 76.10-10(l).

- **Fire Main**

- The diameter of the fire main on vessels on an international voyage shall be sufficient for the effective distribution of the maximum required discharge from two fire pumps operating simultaneously per 46 CFR 76.10-15(c). **Note:** This is in addition to 76.10-5(c). The discharge of this quantity of water through hoses and nozzles at a sufficient number of adjacent hydrants shall be at a minimum Pitot tube pressure of approximately 50 psi.

- **SOLAS**

- Vessels on an international voyage must meet SOLAS requirements. See attachment 2 for assistance.

Subchapter H	Description	Capacity and/or PSI
	46 CFR 76.10	
Large Passenger Vessels	Vessels over 100 GT but less than 500 GT. Not on an international Voyage	1 independently driven pump, approx. 50 psi, from the two highest hydrants, pump capacity unspecified., 1 ½ inch hydrants, 5/8 inch nozzle orifices, 50 ft

		hoses.
	Vessels over 100 GT but less than 500 GT. On an international voyage	***2 pumps required, all other things remain the same as above with exception that the pump capacity is derived as indicated at the end of this table.***
	Vessels 500 GT to not over 1500 GT. Not on an international Voyage	2 independently driven pumps, each approx. 50 psi, from the 2 highest hydrants, pump capacity unspecified, 1 ½ inch hydrants, 5/8 inch nozzle orifices, 50 ft hoses.
	Vessels 500 GT to not over 1500 GT on an international voyage	***All things remain the same as above with exception that the pump capacity is derived as indicated at the end of this table.***
	Vessels 1500 GT to not over 4000 GT not on an international voyage	2 independently driven pumps, each approx. 50 psi, from the 2 highest hydrants, pump capacity unspecified, 2 ½ inch hydrants, 7/8 inch nozzle orifices, 50 ft hoses.[1]
	Vessels 1500 GT to not over 4000 GT on an international voyage	***All things remain the same as above with exception that the pump capacity is derived as indicated at the end of this table.***
	Vessels 4000 GT and over not on an international voyage	3 independently driven pumps, each approx. 50 psi, from the 2 highest hydrants, pump capacity unspecified, 2 ½ inch hydrants, 7/8 inch nozzle orifices, 50 ft hoses.[1]
	Vessels 4000 GT and over on an international voyage	***All things remain the same as above with exception that the pump capacity is derived as indicated at the end of this table.***
	Table 1 **Sub Chapter H**	
	Pump capacity for vessels on an international voyage	
	$d = 1 + \sqrt{\frac{L(B+D)}{2500}}$ in English units or	Minimum **TOTAL** fire pump capacity to be at least equal to 2/3's of the

	$d = 25 + \sqrt{L(B+D)}$ in metric units Find diameter and select pipe size. After pipe size is selected, determine the internal area and then determine capacity required of the bilge pump from the following equation: 6.67 x Area (in^2) ---------- = Q (GPM) .3208 Total Fire Pump Capacity = 2Q/3	required **TOTAL** bilge pump capacity which is sized according to formula 1 in subchapter (F) – 46 CFR 56.50-50 depending on the required diameter of the bilge suction inlet which is calculated from L, B, and D, in order to achieve a minimum velocity of 400 fpm. On passenger vessels, on an international voyage, each of the required pumps must be not less than 80% of the **TOTAL** required capacity divided by the required number of pumps. See 46 CFR 56.50-50 for more detail
Note 1) 75'of hose and 5/8 inch nozzle orifices s may be permitted on interior hydrants, on vessels over 1500 GT on an international voyage. ***Ref: Table 76.10-5(a) and 76.10-10(b)***	**Note 2) When 1 ½ hoses are used in lieu of 2 ½ hoses, the required pump capacity is determined as if 2 ½ hoses are installed. Two 1 ½ hoses connected to the hydrant is considered equal to one 2 ½ hose for this purpose.**	
	Table 2	

Attachments

Attachment 1: **FIRE PUMP LOCATION / SEPARATION OF SPACES**

Attachment 2: **SOLAS REVIEW GUIDE - FIRE MAIN**

Subchapter I - Fire Main Systems

Procedure Number: E1-9 Revision Date: 9/9/99

References

(i) Navigation and Vessel Inspection Circular No. 6-72, Chg. 1, Guide to Fixed Fire Fighting Equipment Aboard Merchant Vessels
(j) The International Convention for the Safety of Life at Sea (SOLAS), 1974, and its Protocol of 1978

(k) 46 CFR 95.10 (Sub Chapter "I") Fire Main System, Details
(l) 46 CFR Part 56 (Sub Chapter "F") Marine Engineering

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➢ Vessels not over 100 GT and 65 'or less in length

Fire Pumps

- On vessels of 65 feet in length or less, the pump may be hand operated per note 1 of 46 CFR Table 95.10-5(a).

Fire Main, Hydrants, and Hoses

- On vessels of 65 feet in length or less, ¾-inch hose of good commercial grade together with a commercial garden hose nozzle may be used per note 1 of 46 CFR Table 95.10-5(a).
- Where ¾ -inch hose is permitted by Table 95.10-5(a), the Pitot tube pressure need be only 35 p.s.i per 46 CFR 95.10-5(c).
- On vessels of 65 feet in length or less, the length of hose shall be sufficient to assure coverage of all parts of the vessel per note 1 of 46 CFR Table 95.10-5(a).
- Where 3/4 inch (19 millimeters) hose is permitted by table 95.10-5(a), the hose and couplings shall be of good commercial grade per 46 CFR 95.10-10(n)(2).

➢ Vessels 100 GT and above or greater than 65 ’in length

Fire Pumps

- Fire pumps, hydrants, hose, and nozzles shall be installed on all self-propelled vessels per 46 CFR 95-05(a)(1). See Table 1 for guidance.
- Fire pumps, hydrants, hose, and nozzles shall be installed on all barges with sleeping accommodations for more than 12 per 46 CFR 95-05(a)(2).
- Each pump shall be capable of delivering water simultaneously from the two highest outlets at a Pitot tube pressure of approximately 50 p.s.i per 46 CFR 95.10-5(c).
- Pumps connected to oil lines may not be used as a fire pump per 46 CFR 95.10-5(f).
- Fire pumps shall be fitted on the discharge side with relief valves set to relieve at 25 p.s.i. in excess of the pressure necessary to maintain 50 psi at the two highest outlets simultaneously or 125 p.s.i., whichever is greater per 46 CFR 95.10-5(d). Relief valves may be omitted if the pumps, operating under shut-off conditions, are not capable of developing a pressure exceeding this amount.
- The total area of the pipes leading from a pump shall not be less than the discharge area of the pump per 46 CFR 95.10-5(g).
- On vessels with oil fired boilers, either main or auxiliary, or with internal combustion propulsion machinery, where 2 fire pumps are required, they shall be located in separate spaces, and the arrangement of pumps, sea connections, and sources of power shall be such as to insure that a fire in any one space will not put all of the fire pumps out of operation per 46 CFR 95.10-5(h). See attachment 1 for determination of acceptable separation schemes.
- Where it is shown to the satisfaction of the Commandant that it is unreasonable to locate the fire pumps in separate spaces due to the size or arrangement of the vessel, or for other reasons, the installation of a total flooding carbon dioxide system may be accepted as an alternate method of extinguishing any fire which would affect the powering and operation of at least one of the required fire pumps per 46 CFR 95-10.5(h).

- Fire pumps shall be fitted with a pressure gage on the discharge side of the pumps per 46 CFR 95.10-5(e).
- Fire pumps may be used for other purposes provided at least one of the required pumps is kept available for use on the fire system at all times per 46CFR 95.10-5(f).

Fire main and hydrants

- On vessels of 500 gross tons and over there must be at least one shore connection to the fire main available to each side of the vessel in an accessible location per 46 CFR 95.10-10(c).

- Suitable cut-out valves and check valves must be provided for required shore connections per 46 CFR 95.10-10(c).
- Suitable adapters must be provided for furnishing the vessel's shore connections with couplings mating those on the shore fire lines per 46 CFR 95.10-10(c).
- Fire hydrants shall be of sufficient number and so located that any part of the vessel, other than main machinery spaces, accessible to persons on board while the vessel is being navigated and all cargo holds may be reached with at least 2 streams of water from separate outlets, at least one of which shall be from a single length of hose per 46 CFR 95.10-10(d).
- In main machinery spaces, all portions of such spaces shall be capable of being reached by at least 2 streams of water, each of which shall be from a single length of hose from separate outlets per 46 CFR 95.10-10(d). This requirement need not apply to shaft alleys containing no assigned space for the stowage of combustibles.
- All parts of the fire main located on exposed decks shall either be protected against freezing or be fitted with cut-out valves and drain valves so that the entire exposed parts of such piping may be shut off and drained in freezing weather per 46 CFR 95.10-10(e). Except when closed to prevent freezing, such valves shall be sealed open per 46 CFR 95.10-10(e)
- The outlet at the fire hydrant shall be limited to any position from the horizontal to the vertical pointing downward, so that the hose will lead horizontally or downward to minimize the possibility of kinking per 46 CFR 95.10-10(f).
- Each fire hydrant must have at least one length of firehose, a spanner, and a hose rack or other device for stowing the hose per 46 CFR 95.10-10(g)
- Fire hydrants, nozzles, and other fittings shall have threads to accommodate the hose connections required in 46 CFR 95.10-10(l) per 46 CFR 95.10-10(m).
- Fire station hydrant connections shall be brass, bronze, or other equivalent metal per 46 CFR 95.10-10(n)(1).
- Branch lines connected to the fire main for purposes other than fire and deck wash shall be so arranged that adequate water can be made continuously available for firefighting purposes per 46 CFR 95.10-5(f).
- Fire hydrants shall be numbered as required by 46 CFR 97.37-15.

Fire Hose and Nozzles

- The size of fire hydrants, hose, and nozzles and the length of hose required shall be as noted in Table 95.10-5(a) per 46 CFR 95.10-10(a).
- On vessels over 1500 GT, 75 feet of 1 ½ -inch hose and 5/8 inch nozzle may be used on interior hydrants with 1 ½ -inch siamese connections per note 2 of 46 CFR Table 95.10-5(a) and 46 CFR 95.10-10(b). In addition, if all such stations can be satisfactorily served with 50-foot lengths, 50-foot hose may be used.

- Each firehose on each hydrant must have a combination solid stream and water spray firehose nozzle approved under 46 CFR subpart 162.027 per 46 CFR 95.10-10(i)
- Firehose nozzles previously approved under 46 CFR subpart 162.027 may be retained so long as they are maintained in good condition to the satisfaction of the Officer in Charge, Marine Inspection per 46 CFR 95.10-10(i).
- In each propulsion machinery space containing an oil fired boiler, internal combustion machinery, or oil fuel unit on a vessel on an international voyage or of 1000 gross tons or more, each firehose having a combination nozzle previously approved under subpart 162.027 of this chapter must have a low-velocity water spray applicator that is also previously approved under subpart 162.027 of this chapter. The length of the applicator must be less than 1.8 meters (6 feet).
- The length of the fire hose applicator must be less than 1.8 meters (6 feet) per 46 CFR 95.10-10(j).
- Fir hose couplings shall either: use National Standard fire hose coupling 9 threads per inch for the 1 ½ inch (38 millimeter) and 7 ½ threads per inch for 2 ½ inch (64 millimeter) hose sizes; or be a uniform design for each hose diameter throughout the vessel per 46 CFR 95.10-10(n)(1)(i).
- Each section of firehose must be lined commercial firehose that conforms to Underwriters' Laboratories, Inc. Standard 19 or Federal Specification ZZ-H-451E. Hose that bears the label of Underwriters' Laboratories, Inc. as lined firehose is accepted as conforming to this requirement per 46 CFR 95.10-10(n)(3).
- Fire hose shall be connected to the outlets at all times, but may be temporarily removed from fire hydrants on open decks or cargo decks due to heavy weather or cargo handling operations but must be stored in an accessible nearby location per 46 CFR 95.10-10(h).
- Fixed brackets, hooks, or other means for stowing an applicator must be next to each fire hydrant that has an applicator per 46 CFR 95.10-10(k).
- Fire hose shall not be used for any other purpose than fire extinguishing, drills, and testing per 46 CFR 95.10-10(l).

Piping

- All piping, valves, and fittings shall meet the applicable requirements of subchapter F (Marine Engineering) per 46 CFR 95.10-15(a)
- All distribution cut-off valves shall be marked as required by 46 CFR 97.31-10 per 46 CFR 95.10-15(b).

➢ Systems contracted for prior to May 26th, 1965

- Installations contracted before May 26, 1965 must meet the requirements outlined in 46 CFR 95.10-90.

➢ Additional Requirements For Vessels on an International Voyage

Fire pumps

- On vessels of 1,000 gross tons and over on an international voyage, each required fire pump, while delivering water thru the fire main system at a pressure capable of delivering 50 psi simultaneously to the two highest outlets, shall have a minimum capacity of at least two-thirds of that required for an independent bilge pump. However, in no case shall the capacity of each fire pump be less than that otherwise required by 46 CFR part 95 per 46 CFR 95.10-5(b).

- **Fire main**

- The diameter of the fire main on vessels on an international voyage shall be sufficient for the effective distribution of the maximum required discharge from two fire pumps operating simultaneously per 46 CFR 95.10-15(c). **Note:** This is in addition to 95.10-5(c). The discharge of this quantity of water through hoses and nozzles at a sufficient number of adjacent hydrants shall be at a minimum Pitot tube pressure of approximately 50 psi.

- **Fire hydrants, and hose**

- Vessels of 500 gross tons and over on an international voyage, must be provided with at least one international shore connection complying with ASTM F-1121 per 46 CFR 95.10-10(c).
- Facilities must be available enabling an international connection to be used on either side of the vessel per 46 CFR 95.10-10(c).
- In each propulsion machinery space containing an oil fired boiler, internal combustion machinery, or oil fuel unit on a vessel on an international voyage or of 1000 gross tons or more, each firehose having a combination nozzle previously approved under subpart 162.027 of this chapter must have a low-velocity water spray applicator that is also previously approved under subpart 162.027 of this chapter. The length of the applicator must be less than 1.8 meters (6 feet).
- The length of the fire hose applicator must be less than 1.8 meters (6 feet) per 46 CFR 95.10-10(j).
- Fixed brackets, hooks, or other means for stowing an applicator must be next to each fire hydrant that has an applicator per 46 CFR 95.10-10(k).

- **SOLAS**

- Vessels on an international voyage must meet SOLAS requirements. See attachment 2 located at the end of this document for assistance.

Attachments

Attachment 1: **FIRE PUMP LOCATION / SEPARATION OF SPACES**

Attachment 2: **SOLAS REVIEW GUIDE - FIRE MAIN**

Subchapter	Description	Capacity and/or PSI
(I)	**46 CFR 95.10**	
Cargo & Miscellaneous Vessels	Vessels not over 100 GT and less than 65'	May have hand pump operated with ¾" garden hose, 35psi, from two highest hydrants.
	Vessels 100 to 1000 GT	1 independently driven pump, approx. 50 psi, from the two highest hydrants, capacity unspecified.
	Vessels 1000 GT and over, not on an international voyage	2 independently driven pumps, each approx. 50 psi, from the two highest hydrants, capacity unspecified.
International Voyages	Vessels 1000 GT and over on an international voyage	2 independently driven pumps, each approx. 50 psi minimum, from the two highest hydrants. See note 1

	Pump capacity for vessels on an international voyage $d = 1 + \sqrt{\frac{L(B+D)}{2500}}$ in English units or $d = 25 + \sqrt{L(B+D)}$ in metric units Find diameter and select pipe size. After pipe size is selected, determine the internal area and then determine capacity required of the bilge pump from the following equation: 6.67 x Area (in^2) ---------- = Q (GPM) .3208 Total Fire Pump Capacity = 2Q/3 **Table 1**	of Subchater (H) in this guide for capacity details. Each required fire pump, while delivering water thru the fire main capable of delivering 50 psi to the two highest outlets shall have a minimum capacity of at least equal to 2/3's of that required for an independent bilge pump which is sized according to formula 1 in subchapter (F) – 46 CFR 56.50-50 depending on the required diameter of the bilge suction inlet which is calculated from L, B, and D, in order to achieve a minimum velocity of 400 fpm. N**ote 1) 75'of 1½ inch hose and 5/8 inch nozzle orifices may be permitted on interior hydrants, on vessels over 1500 GT on an international voyage.** ***Ref: Table 95.10-5(a) and 95.10-10(b)*** **Note 2) When 1½ hoses are used in lieu of 2½ hoses, the required pump capacity is determined as if 2½ hoses are installed per 46 CFR 95.10-5(c). Two 1½ hoses connected to the hydrant is considered equal to one 2½ hose for this purpose.**

Subchapter I-A - Fire Main Systems

Procedure Number: E1-9 Revision Date: 9/9/99

References

(m) Navigation and Vessel Inspection Circular No. 6-72, Chg. 1, Guide to Fixed Fire Fighting Equipment Aboard Merchant Vessels
(n) The International Convention for the Safety of Life at Sea (SOLAS), 1974, and its Protocol of 1978
(o) 46 CFR 108.415 (Sub Chapter "I-A") Fire Main System, Details
(p) 46 CFR Part 56 (Sub Chapter "F") Marine Engineering

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E-mail: customerservicemsc@msc.uscg.mil
Phone: 202-366-6480.

➢ Vessels not over 100 GT and 65 ’or less in length

Fire Pumps

- A fire main system must have at least two independently driven fire pumps that can each deliver water at a continuous pitot tube pressure of approximately 50 psi (3.5 kpa) through at least two fire hose nozzles that are connected to the highest two fire hydrants on the unit per 46 CFR 108.415. **Note:** Alternative designs that meet the pressure requirement of this paragraph will be considered for column stabilized and self elevating units.

- Each fire pump in a fire main system must have a relief valve on its discharge side that is set to relieve at approximately 25 psi (1.75 kpa) in excess of the pump discharge pressure necessary to meet the 50 psi pressure required in 46 CFR 108.415 for the pump or approximately 125 psi (8.6 kpa), whichever is greater per 46 CFR 108.417(a). **Note:** A relief valve may be omitted if the pump operating under shut off condition is not capable of developing the pressure necessary to maintain 50 psi as described in 46 CFR 108.415 plus 25 psi (1.75 kpa).
- If a fire pump is used in a system other than the fire main system, except for branch lines connected to the fire main for deck washing, each pipe connecting the other system must be connected to the pump discharge through a shut off valve at a manifold near the pump per 46 CFR 108.417(c).
- If the fire pump exceeds the pressure in 46 CFR 108.417(a), the pipe leading from the discharge manifold to other portions of the fire main system must

have a reducing station and a pressure gauge in addition to the pressure gauge required by 46 CFR 417(b) per 46 CFR 108.417(c).

- If a fire pump has a reducing station, the relief valve required by 46 CFR 108.417(a) for the pump and the additional pressure gauge required by 46 CFR 108.417(c) must not be located on the discharge side of the reducing station.
- An oil line must not be connected to a fire pump per 46 CFR 108.417(e).
- Each fire pump and its source of power, controls, sea connections for the fire pump, and booster pumps, if installed, must be installed in locations where, if a fire occurs in an enclosed space, all of the fire pumps on the unit are not made inoperative per 46 CFR 108.421. However, if compliance with this requirement is impracticable, a gas type extinguishing system may be installed to protect at least one of the fire pumps, its source of power, and controls per 46 CFR 108.421.
- Each fire pump in a fire main system must have a pressure gauge on its discharge side per 46 CFR 108.417(b).
- Fire pumps may be used for other purposes. However, one of the required pumps must be kept available for use on the fire system at all times per 46 CFR 108.417(c).

Fire Main, Hydrants, and Hoses

- The diameter of the fire main must be sufficient for the effective distribution of the maximum required discharge from two fire pumps operating simultaneously per 46 CFR 108.419
- A fire main system must have enough fire hydrants so that each accessible space may be sprayed with at least two spray patterns of water per 46 CFR 108.423(a).

- In a main machinery space, except a shaft alley with no assigned space for stowage of combustibles, each of the two required spray patterns of water must be from one length of fire hose and each must be from a separate outlet per 46 CFR 108.423(b).
- In all other spaces at least one of the two required spray patterns of water must be from one length of fire hose per 46 CFR 108.423(b).
- No outlet on a fire hydrant may point above the horizontal per 46 CFR 108.423(c).
- Each part of the fire main system located on an exposed deck must either be protected against freezing or be fitted with cutout valves and drain valves to shut off and drain the entire exposed system in freezing weather per 46 CFR 108.429(b).
- Each fire hydrant must have at least one spanner and at least one fire hose rack or reel per 46 CFR 108.423(d).
- Each pipe and fire hydrant in a fire main system must be installed to the extent practicable in locations that are not exposed to damage by materials that are moved on or onto the deck per 46 CFR 108.429(a).

Fire Hose and Nozzles

- Each length of fire hose in a fire main system must be--of 1 ½ or 2 ½ inch nominal hose size diameter; of 50 foot nominal hose size length; and lined commercial fire hose that meets Standard 19 of the Underwriters' Laboratories, Inc., (1971 edition) or Federal Specification ZZ-H-451f. per 46 CFR 108.425(a).
- Fire station hydrant connections shall be brass, bronze, or other equivalent metal per 46 CFR 108.425(b).
- Hose and hydrant couplings shall either use National Standard fire hose coupling threads for the 1 ½ inch (38 millimeter) and 2 ½ inch (64 millimeter) hose sizes, i.e., 9 threads per inch for 1 ½ inch hose, and 7 ½ threads per inch for 2 ½ inch hose; or be a uniform design for each hose diameter throughout the vessel per 46 CFR 108.425(b)(1).
- Each nozzle for a firehose in a fire main system must be a combination solid stream and water spray firehose nozzle that is approve under 46 CFR 162.027 per 46 CFR 108.425(c). **Note**: Combination solid stream and water spray nozzles previously approved under subpart 162.027 of this chapter may be retained so long as they are maintained in good condition to the satisfaction of the Officer in Charge, Marine Inspection per 46 CFR 108.425(c).

- A combination solid stream and water spray firehose nozzle previously approved under subpart 162.027 of this chapter, must have a low-velocity water spray applicator also previously approved under subpart 162.027 of this chapter when installed in machinery spaces containing oil fired boilers, internal combustion machinery or oil fuel units; and on helicopter decks per 46 CFR 108.425(d).

Piping

- All piping, valves, and fittings shall meet the applicable requirements of subchapter F (Marine Engineering) per 46 CFR 95.10-15(a)

- All distribution cut-off valves shall be marked as required by 46 CFR 97.31-10 per 46 CFR 95.10-15(b).

➢ **Additional Requirements**
For Vessels on an International Voyage

- **Fire main**

- A fire main system on a unit in international service must have at least one international shore connection that meets ASTM F-1121 per 46 CFR 108.427(a).
- A fire main system on a unit in international service must have a cutoff valve and check valve for each connection per 46 CFR 108.427(b).
- A fire main system on a unit in international service must have facilities available enabling the international shore connection to be used on either side of the unit per 46 CFR 108.429(c).

- **SOLAS**

- Vessels on an international voyage must meet SOLAS requirements. See attachment 2 located at the end of this document for assistance.

Attachments

Attachment 1: **FIRE PUMP LOCATION / SEPARATION OF SPACES**
Attachment 2: **SOLAS REVIEW GUIDE - FIRE MAIN**

Subchapter K Fire Main Systems

Procedure Number: E1-9 Revision Date: 9/9/99

References

(q) Navigation and Vessel Inspection Circular (NVIC) No. 6-72, Chg. 1, Guide to Fixed Fire Fighting Equipment Aboard Merchant Vessels
(r) The International Convention for the Safety of Life at Sea (SOLAS), 1974, and its Protocol of 1978
(s) 46 CFR 118.300 (Sub Chapter "K") Fire Main System, Details
(t) 46 CFR Subpart 119 (Sub Chapter "K") Piping Systems
(u) 46 CFR 76.10 (Sub Chapter "H") Fire Main System, Details
(v) 46 CFR Subpart 56.60 (Sub Chapter "F") Materials

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Phone: 202-366-6480.

Vessels less than 100 GT, carrying 150 to 600 passengers, without overnight accommodations or having overnight accommodations for not more than 49

Fire Pumps

- A self-priming, power driven fire pump must be installed on each vessel per 46 CFR 118.300(a). See Table 1 at the end of this document for additional guidance.
- The fire pump must be capable of delivering a single hose stream from the highest hydrant, through the required hose and nozzle, at a pitot tube pressure of 50 psi per 46 CFR 118.300(b).
- The fire pump must be permanently connected to the fire main and may be connected to the bilge system per 118.300(d).
- The fire pump must be capable of both remote operation from the operating station and local operations at the pump per 46 CFR 118.300(e)
- The fire pump outlet must be fitted with a pressure gauge per 46 CFR 181.300(b).

Fire Main and Hydrants

- The vessel must have a sufficient number of fire hydrants to reach any part of the vessel using a single length of fire hose per 118.310(a).
- Piping, valves, and fittings in a fire main system must comply with subpart G, part 119, per 118.310(b).
- Each fire hydrant must have a valve installed to allow the fire hose to be removed while the fire main is under pressure per 46 CFR 118.310(c).

Fire Hose and Nozzles

- A fire hose with a nozzle must be attached to each fire hydrant at all times per 46 CFR 118.320(a)
- Fire hoses must be commercial lined conforming to Underwriters Laboratory (UL) 19 ``Lined Fire Hose and Hose Assemblies," or be listed and labeled by an independent laboratory recognized by the Commandant as being equivalent in performance per 46 CFR 118.320(b)(1).
- Fire hoses must be 15.25 meters (50 feet) in length and 40 millimeters (1.5 inches) in diameter per 46 CFR 118.320(b)(2)
- Fire hoses fittings must be of brass or other suitable corrosion-resistant material that comply with National Fire Protection Association (NFPA) 1963 ``Standard for Fire Hose Connections," or other standard specified by the Commandant per 46 CFR 118.320(b)(3).
- Fire hose nozzles must be of a type approved in accordance with approval series 162.027; or be of a type recognized by the Commandant as being equivalent in performance per 46 CFR 118.320(c)(1)&(2).
- Fire hoses temporarily removed from fire hydrants on open decks or cargo decks due to heavy weather or cargo handling operations must be stored in nearby accessible locations per 46 CFR 118.320(a).

Vessels carrying more than 600 passengers or having overnight accommodations for more than 49

Fire Pumps

- Each pump shall be capable of delivering water simultaneously from the two highest outlets at a Pitot tube pressure of approximately 50 p. s. i. per 46 CFR 76.10-5(b).
- Fire pumps shall be fitted on the discharge side with relief valves set to relieve at 25 psi in excess of the pressure necessary to maintain 50 psi at the two highest outlets simultaneously or 125 psi., whichever is greater per 46 CFR 76.10-5(d). Relief valves may be omitted if the pumps, operating under shut-off conditions, are not capable of developing a pressure exceeding this amount.
- Pumps connected to oil lines may not be used as a fire pump per 46 CFR 76.10-5(f).
- Branch lines connected to the fire main for purposes other than fire and deck wash shall be so arranged that the required pressure and capacities of the fire pump and any other services installed on the fire main can be met simultaneously per 46 CFR 76.10-5(f).
- The total area of the pipes leading from a pump shall not be less than the discharge area of the pump per 46 CFR 76.10-5(g).

- On vessels with oil fired boilers, either main or auxiliary, or with internal combustion propulsion machinery, where 2 fire pumps are required, they shall be located in separate spaces, and the arrangement of pumps, sea connections, and sources of power shall be such as to insure that a fire in any one space will not put all of the fire pumps out of operation per 46 CFR 76.10-5(h). See attachment 1 – Fire Pump Location / Separation of Space.
- Where it is shown to the satisfaction of the Commandant that it is unreasonable to locate the fire pumps in separate spaces due to the size or arrangement of the vessel, or for other reasons, the installation of a total flooding carbon dioxide system may be accepted as an alternate method of extinguishing any fire which would affect the powering and operation of at least one of the required fire pumps per 46 CFR 76-10.5(h).
- Vessels on an international voyage shall have a minimum total fire pump capacity at least equal to two-thirds of the required total bilge pump capacity, but in no case less than that required per 46 CFR 76.10-5(b).
- Each of the required fire pumps, on a vessel on an international voyage, shall have a capacity not less than 80 percent of the total required capacity divided by the number of required pumps per 46 CFR 76.10-5(b).
- Fire pumps shall be fitted with a pressure gage on the discharge side of the pumps per 46 CFR 76.10-5(e).
- Fire pumps may be used for other purposes provided at least one of the required pumps is kept available for use on the fire system at all times per 46 CFR 76.10-5(f).

Fire Main and Hydrants

- Fire hydrants shall be of sufficient number and so located that any part of the vessel, other than main machinery spaces, accessible to the passengers or crew while the vessel is being navigated and all cargo holds may be reached with at least two streams of water from separate outlets, at least one of which shall be from a single length of hose per 46 CFR 118.310(d) & 46 CFR 76.10-10(d). **Note:** For the purpose of this requirement, all watertight doors and all doors in main vertical zone bulkheads and stairway enclosures shall be closed, although hose ports may be installed in doors other than watertight doors and doors in main vertical zone bulkheads for the passage of the hose.
- In main machinery spaces, all portions at such spaces shall be capable of being reached by at least two streams of water, each of which shall be from a single length of hose from separate outlets; however, this requirement need not apply to shaft alleys containing no assigned space for the stowage of combustibles per 46 CFR 118.310(d) & 46 CFR 76.10-10(d).
- Fire hydrants must be 1½ - inch in size per 46 CFR 118.310(d) & 46 CFR Table 76.10-5(a).
- Each fire hydrant must have at least one length of 50 ft fire hose, a spanner, and a hose rack or other device for stowing the hose per 46 CFR 118.310(d), 46 CFR Table 76.10-5(a), & 46 CFR 76.10-10(g).

- All parts of the fire main located on exposed decks shall either be protected against freezing or be fitted with cut-out valves and drain valves so that the entire exposed parts of such piping may be shut off and drained in freezing weather. Except when closed to prevent freezing, such valves shall be sealed open per 46 CFR 118.310(d) & 46 CFR 76.10-10(e).
- The outlet at each fire hydrant shall be provided with a cock or valve fitted in such a position that the fire hose may be removed while the fire main is under pressure per 46 CFR 118.310(d) & 46 CFR 76.10-10(f)..
- Outlets shall be limited to any position from the horizontal to the vertical pointing downward, so that the hose will lead horizontally or downward to minimize the possibility of kinking per 46 CFR 118.310(d) & 46 CFR 76.10-10(f).
- Fire hydrants shall be numbered as required 46 CFR 78.47-20 per 46 CFR 118.310(d) & 46 CFR 76.10-10(d).

Fire Hose and Nozzles

- Fire hoses must be 50 ft in length per 46 CFR 118.310(d) & 46 CFR Table 76.10-5(a).
- Each firehose on each hydrant must have a combination solid stream and water spray firehose nozzle that meets the requirements in subpart 162.027 of this chapter per 46 CFR 118.310(d) & 46 CFR 76.10-10(j).
- Firehose nozzles previously approved under subpart 162.027 of this chapter may be retained so long as they are maintained in good condition to the satisfaction of the Officer in Charge, Marine Inspection per 46 CFR 118.310(d) & 46 CFR 76.10-10(j).
- The fire nozzle orifice must be ½ inch in size per 46 CFR 118.310(d) & 46 CFR Table 76.10-5(a).
- Firehose nozzles previously approved under subpart 162.027 of this chapter must have low-velocity water spray applicators also previously approved under subpart 162.027 of this chapter as follows:
- Accommodation and service areas must have two fire hoses with low-velocity water spray applicators of not more than 1.8 meters (6 feet)per 46 CFR 118.310(d) & 46 CFR 76.10-10(k)(1).
- Each fire hose in propulsion machinery spaces containing an oil-fired boiler, internal combustion machinery, or oil fuel unit on a vessel on an international voyage must have low-velocity water spray applicators of not more than 1.8 meters (6 feet)per 46 CFR 118.310(d) & 46 CFR 76.10-10(k)(2).
- Fire hydrants, nozzles, and other fittings shall have threads to accommodate the hose connections noted in 46 CFR 76.10-10(l).
- Fire station hydrant connections shall be brass, bronze, or other equivalent metal per 46 CFR 118.310(d) & 46 CFR 76.10-10(n)(1)
- Fire hose couplings shall either: use National Standard fire hose coupling 9 threads per inch for 1 ½ inch (38 millimeter), or be a uniform design for each hose diameter throughout the vessel per 46 CFR 76.10-10(n)(1)(i)&(ii).

- Each section of firehose must be lined commercial firehose that conforms to Underwriters' Laboratories, Inc. Standard 19 or Federal Specification ZZ-H-451E per 46 CFR 118.310(d) & 46 CFR 76.10-10(n)(2). **Note:** Hose that bears the label of Underwriters' Laboratories, Inc. as lined firehose is accepted as conforming to this requirement.
- Fixed brackets, hooks, or other means for stowing an applicator must be next to each fire hydrant that has an applicator per 46 CFR 118.310(d) & 46 CFR 76.10-10(l).
- Fire hose shall be connected to the outlets at all times. However, on open decks where no protection is afforded to the hose in heavy weather, or where the hose may be liable to damage from the handling of cargo the hose may be temporarily removed from the hydrant and stowed in an accessible nearby location per 46 CFR 118.310(d) & 46 CFR 76.10-10(h).
- Fire hose shall not be used for any other purpose than fire extinguishing and fire drills per 46 CFR 118.310(d) & 46 CFR 76.10-10(i).

- **Piping**

- All piping, valves and fittings must meet the requirements of 46 CFR part 119 and be otherwise acceptable to the OCMI per 46 CFR 119.700.
- Piping used in a fire main system must meet 46 CFR 56.60, except that nonferrous metalic piping as specified in 46 CFR 119.730 may used per 46 CFR 119.710(c).
- Aluminum firemain piping is acceptable on aluminum hulled vessels per 46 CFR 119.730(a)(3) so long as a fixed CO2 system is installed in high risk fire areas in order to protect the firemain piping as required by 46 CFR 119.730(b)(1).
- Provisions must be made to protect piping systems using aluminum alloys in high risk fire areas due to the low melting point of aluminum alloys per 46 CFR 119.730(b)(1). (MSC recognizes fixed CO2 systems)
- If acceptable to the cognizant OCMI, nonferrous metallic piping with a melting temperature above 927 deg. C (1,700 deg. F) may be used in firemain systems that are deemed to be galvanically compatible per 46 CFR 119.730(a)(4).
- Note: Melting Points: Aluminum: 1220°F
  - Copper: 1981°F
  - Iron 2802°F
- Provisions must be made to prevent or mitigate the effect of galvanic corrosion due to the relative solution potentials of copper, aluminum, and alloys of copper and aluminum, which are used in conjunction with each other, steel, or other metals and their alloys per 46 CFR 119.730(b)(2).
- Suitable thread compound must be used in making up threaded joints in aluminum pipe to prevent seizing per 46 CFR 119.730(b)(3).

- Pipe in the annealed temper must not be threaded per 46 CFR 119.730(b)(3).
- The use of aluminum alloys with a copper content exceeding 0.6 percent is prohibited per 46 CFR 119.730(b)(4).

SOLAS

Vessels on an International voyage must also meet SOLAS requirements.

Attachments

Attachment 1: **FIRE PUMP LOCATION / SEPARATION OF SPACES**
Attachment 2: **SOLAS REVIEW GUIDE - FIRE MAIN**

Subchapter	Description	Capacity and/or PSI
(K)	**46 CFR 118.300**	
(Vessels less than 100 GT carrying 150 to 600 passengers or having overnight accommodations for more than 49)	All vessels without overnight accommodations or with overnight accommodations for not more than 49 and not carrying more than 600 Passengers	1 self-priming, power driven pump, 50 psi minimum, at highest hydrant – capacity of pump unspecified
	Vessels carrying more than 600 passengers or with overnight accommodations for more than 49	Refers to Subchapter (H) 46 CFR 76.10-5 which refers to 46 CFR 76.10
(H)	**46 CFR 76.10**	
	Vessels not over 100 GT Not on an International Voyage	1 independently driven pump, approx. 50 psi, from the two highest hydrants, pump capacity unspecified, 1½ inch hydrants, ½ inch nozzle orifice, 50ft hose lengths.
International Voyages	Vessels not over 100 GT on an International Voyage	2 independently driven pumps, each approx. 50 psi, from the 2 highest

	Table 1	hydrants, pump capacity unspecified, 1½ inch hydrants, ½ inch nozzle orifice, 50ft hose lengths.

Subchapter L - Fire Main Systems

Procedure Number: E1-9 Revision Date: 9/9/99

References

(w) Navigation and Vessel Inspection Circular No. 6-72, Chg. 1, Guide to Fixed Fire Fighting Equipment Aboard Merchant Vessels
(x) The International Convention for the Safety of Life at Sea (SOLAS), 1974, and its Protocol of 1978
(y) 46 CFR 132.100 (Sub Chapter "L") Fire Main System, Details
(z) 46 CFR Part 56 (Sub Chapter "F") Marine Engineering

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➢ Vessels less than 100 GT and not more than 65 ’in length

Fire Pumps

- Each vessel of less than 100 gross tons and not more than 19.8 meters (65 feet) in length may have, instead of a fire main that complies with 46 CFR Part 132, a hand-operated pump and a hose capable of providing an effective stream of water to each part of the vessel per 46 CFR 132.100(b).

Fire Main, Hydrants, and Hoses

- A garden hose of nominal inside diameter of at least 16 millimeters (5/8-inch)may be used if it is as follows:
- Of good commercial grade, constructed of an inner rubber tube, plies of braided-fabric reinforcement, and an outer cover made of rubber or equivalent fire-resistant material per 46 CFR 132.100(c)(1), and
- Fitted with a commercial garden-hose nozzle of high-grade bronze or equivalent metal capable of providing a solid stream and a spray pattern per 46 CFR 132.100(c)(2).

➢ Vessels 100 GT and above or greater than 65 ’in length

Fire Pumps

- Each vessel must be equipped with one self-priming power-driven fire pump capable of delivering a single stream of water from the highest hydrant, through the hose and nozzle at a Pitot-tube pressure of at least 345 kPa (50 psi [pounds per square inch]) per 46 CFR 132.120(a).
- Each fire pump must be fitted on the discharge side with a relief valve set to relieve at either 172 kPa (25 psi) in excess of the pressure necessary to maintain 50 psi or 862 kPa (125 psi), whichever is greater. The relief valve is optional if the pump is not capable of developing pressure exceeding the greater amount per 46 CFR 132.120(c).
- If two propulsion engines are installed, the pump may be driven by one of the engines. If only one propulsion engine is installed, the pump must be driven by a source of power independent of the engine per 46 CFR 132.120(d).
- If two fire pumps are installed, and if one pump remains available for service on the fire main at any time, the other pump may be used for other purposes per 46 CFR 132.120(e).
- Each fire pump must be capable of delivering a single stream of water from the highest hydrant, through the hose and nozzle at a Pitot-tube pressure of at least 50 psi (345 kpa) while meeting any other demands placed on it, such as

by a branch line connected to the fire main for washing the anchor or the deck per 46 CFR 132.120(f).

- No branch line may be directly connected to the fire main except for fighting fires or for washing the anchor or the deck per 46 CFR 132.120(g).
- Each discharge line for any other purpose must be clearly marked and must lead from a discharge manifold near the fire pump per 46 CFR 132.120(g).
- When a fire monitor is connected to the fire main system, it must lead from a discharge manifold near the fire pump per 46 CFR 132.120(h).
- The total cross-sectional area of piping leading from a fire pump may not be less than that of the pump-discharge outlet per 46 CFR 132.120(i).
- In no case may a pump connected to a line for flammable or combustible liquid be used as a fire pump per 46 CFR 132.120(j).
- A fire pump must be capable of both manual operation at the pump and, if a remote operating station is fitted, operation at that station per 46 CFR 132.120(k).
- Each fire pump must be fitted on the discharge side with a pressure gauge per 46 CFR 132.120(b).

Fire main and hydrants

- Except for machinery spaces and shaft alleys, fire stations must be so numerous and so placed that each part of the vessel accessible to persons aboard while the vessel is being operated, and each cargo hold, are reachable by at least two effective spray patterns of water. At least two such patterns must come from separate hydrants and at least one must come from a single length of hose per 46 CFR 132.130(a).
- Each part of the main machinery space, including the shaft alley if it contains space assigned for the stowage of combustibles, must be reachable by at least two streams of water. Each stream must come from a single length of hose, from a separate fire station per 46 CFR 132.130(b).
- Each outlet at a fire hydrant must be at least 1 ½ inch (38 millimeters) in diameter and, to minimize the possibility of kinking, must be fitted so that no hose leads upward from it per 46 CFR 132.130(e).
- Fire main pipe and fire hydrants must be placed so that the fire hose may be easily coupled to them per 46 CFR 132.130(h).
- Each station must be readily accessible per 46 CFR 132.130(h).
- Each fire hydrant or ``Y" branch must be equipped with a valve such that the fire hose may be removed while there is pressure on the fire main per 46 CFR 132.130(i).
- Each fire hydrant connection must be of brass, bronze, or equivalent metal per 46 CFR 132.130(j).
- Each part of the fire main on a weather deck must be either protected against freezing or fitted with cut-out valves and drain valves so that exposed parts of the piping may be shut off and drained in freezing weather. Except when closed against freezing, the cut-out valves must be sealed open per 46 CFR

132.130(d).No deck cargo may interfere with access to fire stations per 46 CFR 132.130(h).

- Each fire main pipe must run as far away from deck cargo as practicable, to avoid risk of damage by the cargo per 46 CFR 132.130(g).
- Each fire station must be numbered in compliance with 46 CFR 131.830 per 46 CFR 132.130(c).

Fire hose and nozzles

- Each fire hydrant must have a fire hose 50 feet (15.2 meters) in length, with a minimum diameter of 1 ½ inches (38 millimeters), connected to an outlet, for use at any time per 46 CFR 132.130(k)
- Each section of fire hose must be lined commercial fire hose, or lined fire hose that meets Standard 19 of Underwriters Laboratories, Inc. (UL) per 46 CFR 132.130(n). **Note:** Hose that bears the UL label as lined fire hose complies with this section.
- The threads of fire hose couplings must be of brass or other suitable corrosion-resistant material and comply with NFPA 1963 per 46 CFR 132.130(j).
- Each fire station must have at least one length of fire hose per 46 CFR 132.130(g).
- Each hose on a fire station must have a fire nozzle approved under subpart 162.027 of this chapter that can discharge both solid stream and water spray per 46 CFR 132.130(g).
- No fire hose, when part of the fire equipment, may be used for any purpose except fire-fighting, fire drills, and testing per 46 CFR 132.130(l).
- A suitable fire hose rack or other device must be provided for each fire hose per 46 CFR 132.130(m).
- Each fire hose rack on a weather deck must be placed so as to protect its fire hose from heavy weather per 46 CFR 132.130(m).
- Each fire station must be equipped with a spanner suitable for use on the hose there attached per 46 CFR 132.130(f).

Piping

- Piping must be hot-dip galvanized; at least extra-heavy schedule; or of a suitable corrosion-resistant material per 46 CFR 132.110.
- Except as provided for liftboats (noted below) by 46 CFR 134.180, each fitting, flange, valve, and run of piping must meet the applicable requirements of 46 CFR part 128 per 46 CFR 132.110.
- Each distribution cut-off valve must be marked in compliance with 46 CFR 131.820 per 46 CFR 132.110(b).

Liftboats - Piping for fire-main suction 46 CFR 134.180

- Suction lines for fire pumps must comply with 46 CFR 132.110 except that suction lines extending below the main deck located outside of the hull plating which supply the fire pump when the liftboat is in the elevated mode must be metallic, unless they comply with the plastic pipe requirements of 46 CFR 56.60-25(c) for vital fresh-water and salt-water service, except that they may be of unlimited length per 46 CFR 134.180(b).

➢ Additional Requirements For Vessels on an International Voyage

Level 1

- **SOLAS**

- Vessels on an international voyage must meet the requirements of SOLAS Chapter 2-II. See attachment 2 for guidance.

Attachments

Attachment 1: **FIRE PUMP LOCATION / SEPARATION OF SPACES**
Attachment 2: **SOLAS REVIEW GUIDE - FIRE MAIN**

Subchapter T - Fire Main Systems

Procedure Number: E1-9 Revision Date: 9/9/99

References

a) Navigation and Vessel Inspection Circular No. 6-72, Chg. 1, Guide to Fixed Fire Fighting Equipment Aboard Merchant Vessels
b) The International Convention for the Safety of Life at Sea (SOLAS), 1974, and its Protocol of 1978
c) 46 CFR 181.300 (Sub Chapter "T") Fire Main System, Details
d) 46 CFR 58.60 (Sub Chapter "F") Materials

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Fire Pumps

- Vessels must be fitted with fire pumps as outlined in Table 1 of this document.
- The fire pump must be capable of projecting a hose stream from the highest hydrant, through the required hose and nozzle, a distance of 7.6 meters (25 feet). 46 CFR 181.300(c).

- The fire pump must be permanently connected to the fire main and may be connected to the bilge system per 181.300(d).
- The fire pump must be capable of both remote operation from the operating station and local operations at the pump per 46 CFR 181.300(e)
- The fire pump outlet must be fitted with a pressure gauge per 46 CFR 181.300(b).

Fire Main and Hydrants

- A vessel that has a power driven fire pump must have a sufficient number of fire hydrants to reach any part of the vessel using a single length of fire hose per 181.310(a).
- Each fire hydrant must have a valve installed to allow the fire hose to be removed while the fire main is under pressure per 46 CFR 181.310(c).

Fire Hose and Nozzles

- (a) A fire hose with a nozzle must be attached to each fire hydrant at all times per 46 CFR 181.320(a)
- Hoses temporarily removed from fire hydrants due to heavy weather or cargo handling operations must be stored in nearby accessible locations per 46 CFR 181.320(a).

Vessels 65’or less in length carrying more than 49 passengers or vessels more than 65’in length

- Fire hoses must be commercial lined conforming to Underwriters Laboratory (UL) 19 ``Lined Fire Hose and Hose Assemblies," or be listed and labeled by an independent laboratory recognized by the Commandant as being equivalent in performance per 46 CFR 181.320(b)(1).
- Fire hoses must be 15.25 meters (50 feet) in length and 40 millimeters (1.5 inches) in diameter per 46 CFR 181.320(b)(2)
- Fire hoses fittings must be of brass or other suitable corrosion-resistant material that comply with National Fire Protection Association (NFPA) 1963 ``Standard for Fire Hose Connections," or other standard specified by the Commandant per 46 CFR 181.320(b)(3).
- The fire nozzle must be of a type approved in accordance with approval series 162.027; or be of a type recognized by the Commandant as being equivalent in performance per 46 CFR 181.320(d)(1)&(2).

Vessels less than 65’in length carrying not more than 49 passengers

- Fire hoses may be commercial lined as noted above, with fittings as noted above, or be a garden type hose of not less than 16 millimeters (0.625 inches) nominal inside diameter per 46 CFR 181.320(c)(1).
- Fire hoses must be of one piece not less than 7.6 meters (25 feet) and not more than 15.25 meters (50 feet) in length per 46 CFR 181.320(C)(2).
- Garden type fire hoses must be of a good commercial grade constructed of an inner rubber tube, plies of braided fabric reinforcement, and an outer cover of rubber or equivalent material, and of sufficient strength to withstand the maximum pressure that can be produced by the fire pump per 46 CFR 181.320(c)(3).
- All fittings on a garden type hose must be of suitable corrosion-resistant material per 46 CFR 181.320(c)(3).
- Each nozzle on a garden type hose must be of corrosion-resistant material and be capable of being changed between a solid stream and a spray pattern per 46 CFR 181.320(d).

- **Piping**

- Piping, valves, and fittings in a fire main system must comply with subpart G, part 182, and be otherwise acceptable to the OCMI per 46 CFR 182.700.
- Aluminum firemain piping is acceptable on aluminum hulled vessels per 46 CFR 182.730(a)(3) so long as a fixed CO2 system is installed in high risk fire areas in order to protect the firemain piping as required by 46 CFR 182.730(b)(1).
- If acceptable to the cognizant OCMI, nonferrous metallic piping with a melting temperature above 927 deg. C (1,700 deg. F) may be used in vital systems that are deemed to be galvanically compatible per 46 CFR 182.730(a)(4).
- Note: Melting Points:

Aluminum:	1220°F
Copper:	1981°F
Iron	2802°F

- Provisions must be made to protect piping systems using aluminum alloys in high risk fire areas due to the low melting point of aluminum alloys per 46 CFR 182.730(b)(1). (MSC recognizes fixed CO2 systems)
- Provisions must be made to prevent or mitigate the effect of galvanic corrosion due to the relative solution potentials of copper, aluminum, and alloys of copper and aluminum, which are used in conjunction with each other, steel, or other metals and their alloys per 46 CFR 182.730(b)(2).
- Suitable thread compound must be used in making up threaded joints in aluminum pipe to prevent seizing per 46 CFR 182.730(b)(3).
- Pipe in the annealed temper must not be threaded per 46 CFR 182.730(b)(3).
- The use of aluminum alloys with a copper content exceeding 0.6 percent is prohibited per 46 CFR 182.730(b)(4).

Subchapter T	Description	Capacity and/or PSI
(T)	**46 CFR 181.300**	
(Vessels less than 100 GT carrying 150 or less passengers or having overnight accommodations for 49 or less)	Vessels over 65 ’and vessels less than 65 ’ carrying more than 49 passengers.	1 self-priming, power driven pump, 50 GPM, 60 psi minimum on gauge at outlet of pump
	Ferry vessels not more than 65 ’carrying not more than 49 passengers	1 self-priming, power driven pump,10 GPM minimum - psi unspecified
	Vessels not more than 65 ’carrying 49 or less passengers.	No power pump required. Vessel must have fire buckets per 46 CFR 181.610
	Table 1	

❑

Attachments

Attachment 1: **FIRE PUMP LOCATION / SEPARATION OF SPACES**
Attachment 2: **SOLAS REVIEW GUIDE - FIRE MAIN**

Attachment 1

Fire Pump Location

Most vessels are required to have two fire pumps with all suctions, sources of power, etc. located in separate spaces so that one casualty will not put all pumps out of operation. The alternative of installing both pumps in the same space and protecting the space with carbon dioxide is a deviation, permitted only in unusual circumstances where the separation of pumps will not increase safety - usually accepted for small vessels only. Such arrangement is a poor substitute for separation of the pumps.

One important objection is that pumps are not required to be controlled from outside of the space. If a fire occurs in the space containing the pumps, the space will become untenable. Even upon discharge of CO2 and extinguishment of the fire, the spaces will remain untenable, delaying the availability of the pumps. There is a strong probability that when the pumps do become available, they will be inoperable.

As a basis for application of the requirement to separate fire pumps, a fire in one space is considered to be of such magnitude that the entire space, including the machinery space casing, is inaccessible and all equipment therein is made inoperable. When a pump powered by the emergency electrical system is to be used as one of the independent fire pumps, compliance with this requirement can be deceptive. Complete independence of fire pumps may be lost due to interdependence between electrical Systems and boilers, because runs of electric cable may be vulnerable to fire in several spaces, and because of non fire-proof boundaries of machinery spaces. Some examples of aspects which must be considered are:

(1) A steam fire pump in the boiler room in combination with an electric fire pump in the engine room supplied from the emergency electrical system may not comply with the regulation. If the boilers are dependent on electrically driven auxiliaries, a fire in the engine room may affect not only the electric fire pump, but also the normal electric supply to the boiler auxiliaries required for operation of the steam fire pump.

(2) An electric fire pump located remotely from the main machinery spaces and supplied from the emergency electrical system in combination with another fire pump in a main machinery space may not comply with the requirement. If the cable supplying the remote pump passes through either the boiler or engineroom a fire in that space will affect the machinery space fire pump and may damage the power supply cable to the remote fire pump.

(3) An electric fire pump located outside the main machinery spaces and supplied from the emergency electrical system by a cable and motor starter attached to a machinery space boundary or casing may not be independent of the machinery space. In this situation it is possible for heat from a fire in the machinery space –to be conducted through the boundary or casing and damage the power supply to the fire pump.

Attachment 1 (Cont.)

(4) An electric pump is located outside of the main machinery spaces and is supplied from the emergency electrical system, the power for which is an independent diesel-drive generator. Location of the fuel supply to the independent diesel-driven generator in the machinery space or casing may nullify the fire pump separation.

In this instance, a machinery space fire could disrupt fuel to the driver for emergency electrical power, thereby putting both fire pumps out of operation.

Separation of Spaces

One additional aspect which must be considered in the arrangement of fire pumps to comply with this requirement concerns "separation" of the spaces. For the purpose of determining compliance with this requirement, the following condition must be met in order for the spaces to be considered "separate."

(1) Any common boundaries between the spaces must be an effective "A" Class fire division.

(2) To insure that a fire in one pump space does not spread rapidly to an adjacent pump space, doors in common boundaries between the spaces shall be either:

(a) Remotely operated Class II watertight doors, or
(b) Remote release, self-closing fire doors (installed alone or in tandem with dogged watertight doors) However, doors on the same level as and in close proximity to continuously manned control stations need not be of the self-closing type.

(3) The spaces shall have independent access. In the advent that there is only a single engine space, it becomes increasingly difficult to find a suitable location for the second fire pump. There are three acceptable solutions to this problem of which the latter is acceptable only in very unusual circumstances. Listed in general order of preference, they are:

(1) Deep well pump - Installation of a deep well pump located in the accommodation and service space area above the machinery space would be acceptable. The suction shaft would pass down through the machinery space where it would take suction from a sea chest. All electrical components and valving would be located inside of the pump room, providing complete independence from the machinery space. Such an arrangement allows simple rapid operation of the system. Some of the problems which must be considered in such a design are:

(a) Provision of a flexible connection between the pump suction shaft and the pump to avoid undue stresses both at the connection and at the sea chest.
(b) Strength of the sea chest or suction shaft support.
(c) Provisions of fire insulation if the pump space immediately adjoins the machinery space.

Attachment 1
(Cont.)

(2) Forward pump - If a bow thruster is provided, the fire pump may be located in the forward portion of the ship with power provided by the bow thruster prime mover. Such

an arrangement would possibly involve a considerable time delay before the pump could be actuated and remote control of the pump and valves from the accommodation area would be necessary.

(3) A separate enclosure - Building a small separate enclosure inside the machinery space with access from outside the machinery space has several drawbacks.

(a) To assure that a fire in the engine space will not affect operation of the second fire pump, water supply, source of power, power cables, etc. should be independent of the machinery space.
(b) Despite all precautions the space may tend to become a "forgotten space," lacking maintenance, collecting debris, etc.
(c) Access to the space is difficult at best and could be a potential safety hazard due the long distance which must be transversed by a vertical ladder.
(d) There would likely be a considerable time delay before the pump could be started in the advent of a fire in the machinery space.

Attachment 2

FIRE MAIN - SOLAS REVIEW GUIDE

Safety of Life at Sea Convention: Chapter II-2: Regulation 4

II-2: 4.2.1.2) Total fire pump capacity. SOLAS requires the **total** capacity of fire pumps on cargo vessels to be not less than 4/3 the quantity required by each independent bilge pump in a passenger ship of the same dimension. However, the total fire pump capacity need not exceed 792 gpm (180 m^3/h).

A. We must first look at the required bilge capacity for a passenger vessel of the same dimension as the OSC. See Regulation II-1:21.2.6. Each power bilge pump must be capable of pumping water through the main bilge pipe at a speed of not less than 5.56 ft/s (2m/s).

B. The diameter of the bilge main is determined by the following formula. See Regulation II-1:21.2.9.

$$d = 25 + 1.68\sqrt{L(B+D)}$$

Where: d = the internal diameter of the bilge main in mm.
L = length of ship in meters.
B = breadth of ship in meters.
D = molded depth of the ship in meters

C. Multiply the area d by 2 m/s to get cubic meters per second, then by 3600s/h to get cubic meters per hour.

D. To convert m^3/h to gpm multiply by 4.4029. This value is the minimum **total** fire pump capacity.

II-2: 4.2.2) Individual pump capacity. Each individual fire pump capacity should be at least 80% the total fire pump capacity above divided by the number of fire pumps required. In no case should an individual fire pump capacity be less than 110 gpm (25 m^3/h). Each pump must be capable of delivery two jets of water at the required pressure.

A. Cargo ships of 1,000 gross tons and more require at least 2 pumps. See Regulation II-2:4.3.1.
B. OSV's less than 1,000 gross tons only require 1 pump IAW 46 CFR 132.120.

Attachment 2 (Cont.)

II-2: 4.3.1) Number of Pumps Required:

Passenger ships of 4000 GT and upwards	At least 3
Passenger ships of less than 4000 GT and cargo ships of 1000 GT and upwards	At least 2

Cargo ships of less than 1000 tons Gross tonnage	To the satisfaction of the Administrtion

II-2: 4.3.3) Requirement for emergency pump. In cargo ships (OSV's) 2,000 gross tons and over, if a fire in one compartment (i.e. the engine room) could put all the fire pumps out of action, an independently driven emergency fire pump shall be provided meeting the following requirements.

A. The emergency pump capacity shall be not less than 40% of the total capacity of the pumps required in Regulation II-2: 4.2.1.2 above. In no case should the pump be less than 110 gpm (25 m^3/h). See II-2:4.3.3.2.1.

B. No direct access shall be permitted between the space with the emergency fire pump and the machinery space. See II-2:4.3.3.2.7.

II-2: 4.3.4) Requirements for other pumps in the machinery space. Where general service pumps, bilge pumps or ballast pumps are fitted in a machinery space, at least one of these pumps must be capable of delivering the required capacity and pressure of water to the fire main via a cross connection.

II-2:4.4.2) Required fire main pressure. With any two pumps operating simultaneously, the following minimum pressure must be maintained at all hydrants:

A. Cargo ships 6000 gross tons and over - 39 psi (0.27 N/mm^2)
B. Cargo ships 1000 to 6000 gross tons - 36 psi (0.25 N/mm^2)
C. Cargo ships under 1000 gross tons – to the satisfaction of the administration.
D. Passenger ships 4000 gross tons and upwards - 45 psi (0.31 N/mm^2)
E. Passenger ships 1000 to 4000 gross tons - 39 psi (0.27 N/mm^2)
F. Passenger ships under 1000 gross tons – to the satisfaction of the administration.